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MONETARY SHOCKS AND THE FARM/NONFARM PRICE RATIO: EMPIRICAL TESTS OF COMPETING HYPOTHESES

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MICHAEL T. BELONGIA

A major policy thrust of the Reagan administration has been to reduce the level of farm subsidies and, where possible, to eliminate programs completely. After seven years, however, few fundamental changes have been made in the basic structure of farm programs and, in fact, the pattern of existing subsidies has been widened to include new commodities in the web of guaranteed loans, price supports, marketing orders, import quotas, acreage reductions and other instruments designed to raise prices of farm products directly, or indirectly by limiting the quantity of output produced. The combined effect of partial adjustments in some programs and the widened scope of others has been to set records for expenditures on farm support, with spending averaging $__________ billion per year since fiscal year 1982.

There are many sound explanations for this persistence in the structure and cost of farm programs.[1/] One particular explanation, which has received a great deal of study but come to substantially different conclusions, is the effects of changes in the growth rate of the money supply. In the view of some economists and agricultural policy makers, expansionary and contractionary money growth causes farm prices and income to vary widely relative to prices and income in the nonfarm sector. According to their studies, this monetary source of instability is viewed to have effects on farmers that are of sufficient size and magnitude to dwarf the effects of commodity programs. In fact, the empirical evidence on large monetary effects has been interpreted by some as a justification for the existence on farm programs as a buffer against monetary disturbances. Other analysts looking at the same question have not denied that changes in money growth affect agriculture; instead, they have found the effects to be small and short-lived. This contrary evidence suggests that conditions in specific commodity markets are the more important cause of declining relative farm prices and real farm income.

This article discusses these alternative views that link changes in money grwth to changes in the farm-nonfarm price ratio and, using the same data set, tests the null hypotheses proposed by each view. Questions about the size, direction and presistence of relative price change in response to a monetary change are important because, if large and persistent, farm policy may need to consider the independent effects of monetary policy on agriculture. Moreover, although changes in monetary actions always have distributional effects across sectors, the existence of particularly large or protracted adjustmnts might be a consideration in policy decisions. The empirical approach - testing alternative models with the same data - also is an important consideration. As King has noted, failure to replicate previous studies or to nest new work within the context of old often leads to a long list of noncomparable studies that, by nature of their varying designs, precludes drawing any consensus verdict on the question being investigated.[2/]

MONEY GROWTH AND RELATIVE PRICES: ALTERNATIVE THEORETICAL RESULTS

Whether changes in money growth affect the farm-nonfarm price ratio has not been a source of disagreement among studies of this question. Rather, the disagreements have been about the direction of relative price change, and the size and persistence of this effect. For example, if the money stock were to grow faster than previously expected, the various theoretical models and supporting empirical evidence discussed below indicate, alternatively, increases or decreases in the relative price ratio and changes that last for as little as six months or as long as several years. But, because the conflicting empirical evidence is based on different measures of prices or the money supply, and estimated over different sample periods by different methods or with data of different frequencies, it is difficult, if not impossible, to make comparisons across studies. In this sense, the debate is largely undecided.

Model 1: A Change in Money Growth as a Shock to Aggregate Demand

One model that has been proposed treats an unexpected increase in the money stock as a positive shock to aggregate demand.[3/] This occurs as people find themselves with an excess supply of real money balances and an excess demand for goods. Their collective actions to restore equilibrium by an increase in spending shift aggregate demand to the right, raising output temporarily and the price level permanently. The income elasticities of demand for farm and nonfarm products suggest the direction of relative price change in this model: so long as the income elasticity of demand for farm products is lower than that of nonfarm products, an unexpected increase in the money stock would reduce the relative price of farm products.[3a/]

In this case, as in the others that follow, this real income effect is a short-run phenomenon and, in the long-run, the relative price ratio is expected to return to its original value. The direction of relative price change and whether this ratio returns to its original value in the long-run are the model's testable hypotheses. Identifying what time interval defines "the short-run"and "the long-run" is an empirical issue to be addressed.

Model 2: Relative Price Changes Caused by Different Elasticities of Supply

A model that predicts a relative price change in the opposite direction also has been advanced. In this model, the short run elasticity of supply of farm producs is argued to be lower than that of nonfarm products because of the nature of the production process. With long lags between planting and breeding decisions and product marketings, the ability to adjust farm output is limited. Other things the same, this physical characterisitic of farm production would caue the farm/non farm reltive price ration initially to rise in response to a positive aggregate demand shock. Again, the existence of long-run neutrality is a testable proposition and the length of the adjustment process must be determined empirically.

Model 3: Price Stickiness and "Overshooting"

Changes in money growth and relative price changes also can be related in an overshooting model.[5/] This model, adapted from the exchange rate literature, assumes prices in one sector adjust to a shock more quickly than other prices; thus, again in the short-run, a monetary shock causes a temporary change in the relative price ratio. A unique feature of this model, however, is that fully anticipated changes in money growth, as well as shocks, can affect the relative price ratio.

Although the derivation of the overshooting model is repeated in the Appendix, it is possible to state its implications in a straight-forward manner. The testable hypotheses implied by the model shown in equation (1) are that a change in the log-level of the money stock (Δm) or in the expected growth rate of money ($\Delta \mu_t$) will affect farm prices. That is, in a regression equation of the form,

(1) $\Delta p_{f,t} = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta \mu_t + \varepsilon_t$,

where $\Delta p_{f,t}$ is the change in the farm/nonfarm price ratio, it is expected that $\beta_1 > 1$ and $\beta_2 > 1$. This predicted increase in the farm-nonfarm price ratio--because farm prices are hypothesized to respond initially respond by a larger percentage than either the actual level of the money stock or the unexpected change in money growth--is contrary to the relative price decline predicted by the Barro-type model (model 1). The overshooting model, however, predicts the same direction of change as that of a model based on different elasticities of supply for farm and nonfarm products. Also in contrast to other models, changes in money growth are hypothesized to have contemporaneous effects on relative prices, but no explicit statement about long-run neutrality or the adjustment process is made.

THE FARM/NONFARM PRICE RATIO SINCE 1976

The recent history of the farm-nonfarm price ratio that each model is attempting to explain is depicted in charts 1 and 2. Using monthly data for the interval January,1976-February,1987, the sample is limited to an era of floating exchange rates, one in which wage and price controls were terminated and the most noticeable effects of the 1972-74 acreage reductions and Soviet grain sales had passed. Thus, although the data still contain the effects of major policy changes, some of the more rotable incidents have been avoided.[6/]

Chart 1 plots the ratios of PPI-farm products/PPI-Industrial Commodities and Prices Received by Farmers/Prices Paid by Farmers; table 1 presents summary statistics for the data.[7/] The plots show considerable variation in these data. The primary source of this variation, shown in Chart 2 for the PPI data, is farm prices, which vary substantially around a stable nonfarm price series; a similar conclusion is reached by looking at individual plots (not shown) of the prices received and prices paid indexes. That the variation in the relative price ratios is caused primarily by variation in farm prices is verified by testing the null hypothesis that the variances of the series are equal. Whether one compares PPIs or the prices paid and prices received indexes, F-statistics of 15.22 and 5.97, respectively, clearly indicate that farm prices have been substantially more variable than nonfarm prices since 1976.[8/]

It also is interesting to note in the plots and the table not only the pronounced and significant negative trend in the relative price ratio, but how deviations from trend coincide with changes in M1 growth. For example, the plots show the relative price ratio falling from 2/1979-6/1980, 9/1980-12/1981 and 1/1984-9/1985. Over the same periods, however, M1 growth was 5.4, 5.4 and 9.0 percent, respectively and, in each case, had decelerated between one and two percentage points from the average growth rate over the previous twelve months. Conversely, the relative price ratio rose between 10/1977-8/1978, 4/1980-12/1980 and 10/1982-4/1984 when, in each case, M1 growth had accelerated from its previous twelve month average.

A casual inspection of the most pronounced movements in the relative price ratio, therefore, seems to be consistent with the predictions of the overshooting and supply response models: changes in money growth from its previous path cause farm prices to adjust more quickly than nonfarm prices. The farm Sector, as many have argued, does appear to bear the initial burden of adjusting to changes in money growth. Whether these are important and lengthy adjustments, however, remains to be determined.

ESTIMATES OF THE MONEY GROWTH - RELATIVE PRICE - RELATIONSHIP

As has been noted earlier, differences in data measurements, sample period, theoretical models and empirical techniques have frustrated attempts to draw firm conclusions about the direction, magnitude and persistence of changes in relative prices in response to a change in the rate of money growth. Because a resolution of this debate is important to the design of farm programs, each of the models discussed previously was estimated with the same data in an attempt to build some consensus result. As a first step, a vector autoregressive (VAR) model was estimated.[9/] These VAR results, which indicate the amount of variation in the relative price ratio that one might attribute to monetary shocks, serve as an approximate guide to the strength of the hypothesized relationship. Then, two reduced form equations from models (1) and (2) were estimated. All equations were estimated over the January 1976-February 1987 sample interval.

VAR Estimation

The VAR model included four variables: the farm/nonfarm price ratio, M1, the real trade-weighted exchange rate and the index of industrial production. The latter two variables were included to represent changes in the quantity demanded of U.S. farm products in response to a change in the effective price to foreign buyers and the growth of nonfarm output, which may account for part of the persistent negative trend in the relative price ratio. All variables were specified as first differences of logarithms. Akaike's (1970) final prediction error (FPE) criterion [also discussed by Batten and Thornton (1984)] was employed to select lag lengths for each of the four equations in the VAR representation. Sums of lagged coefficients, t-statistics for these sums and the lag lengths selected for the single equation estimation are reported in table 2.

The results of interest indicate that only the two most recent months of M1 growth are related to changes in relative farm prices and that the sum of these two coefficients is not significantly different from zero. One possible explanation for TLIS quick adjustment is that flows from farm inventories, which were historically large over most of the sample period, offset any relative price change caused by an aggregate shock. The variables more closely associated with short-run fluctuations in relative prices are past changes in the ratio itself, industrial production and the real exchange rate. There is some evidence of contemporaneous feedback from changes in relative prices to M1 growth. But, the length of lag estimated and the magnitude of its sum coefficient suggest minimal effects of monetary shocks on the farm/nonfarm price ratio.

Variance Decomposition

Further evidence on the effect of monetary shocks on relative prices is found in table 3, which presents the percentage of twelve month ahead forecast error variance explained by past innovations in the relative price ratio and the other variables in the model. Three sets of results are reported for each equation because VAR results are sensitive to the ordering of variables. The various orderings, therefore, suggest a range of possible effects that innovations in one series may have on another.

Consistent with the results reported by Orden, monetary shocks explain less than 10 percent of the relative price forecast error variance, while 73 percent or more is attributable to past innovations in the relative price series itself. Innovations in the real exchange rate series account for 13 percent of the variance in relative farm prices. While some might argue that money shocks are affecting relative prices through an intermediate effect on the exchange rate, note that less than 2 percent of the variance in real exchange rate movements is explained by past innovations in M1; this result is consistent with the small or nonsignificant effects of monetary shocks on the real exchange rate reported by Batten and Belongia (1986). Overall, these results again suggest a weak relationship between monetary shocks and movements in the farm/nonfarm price ratio.

Estimates From a Barro-Type Model

While the foregoing results are suggestive of a weak relationship between monetary shocks and relative price changes, the VAR method is not appropriate for testing the relevant structural hypotheses that characterize the alternative models. In a model that treats a monetary shock as a shock to aggregate demand, a lower income elasticity for farm products would imply that, in the short run, the farm/nonfarm relative price ratio is inversely related to innovations in M1. Moreover, because neoclassical models of this nature recognize that nominal shocks affect real or relative magnitudes only in the short run, one would expect to find the sum of coefficients for lagged innovations in M1 not significantly different from zero. The persistence of any short-run nonneutralities, however, remains to be determined.

The basic predictions of this model can be examined by estimating an equation of the form:

$$\Delta\left(\frac{P_f}{P_{NF}}\right) = a + \sum_{i=o}^{p} b_i \, E(\dot{m})_{t-i} + \sum_{j=o}^{q} c_j \, (\dot{m} - E(\dot{m}))_{t-j} + \varepsilon_t$$

where $E(\dot{m})$ is the expected growth rate of M1 and $(\dot{m} - E(\dot{m}))$ is the unexpected change in M1 growth, a, b_i and c_j are coefficients to be estimated over undetermined log lenths p and q, respectively. The model predicts that the b_i coefficients should be zero, the sum of c_j coefficients should be zero and the initial lags of unexpected changes in money growth should take negative values.

Prior to estimating (2), which is derived in Section I of the Appendix it was necessary to generate values for the aggregate demand shock, (unexpected changes in M1) and the lag lenths p and q. An autoregressive model was fit to its first differences of logarithms and inspection of the autocorrelation functions indicated on AR(1) representation was adequate. The Box-Pierce Q statistic could not reject the null hypothesis that the residuals from this representation were white noise.[10/] These residuals were employed in (2) as the measure of monetary shocks. Lag lenghts were chosen by a final prediction error criterion.[11/]

Estimating (2) as specified produced the results in the first row of table 4. Consistent with theory, anticipated changes in M1 have no effect on relative prices. Unexpected changes in M1, however, have a significant and positive contemporaneous impact, suggesting that an unexpected shift to faster M1 growth causes farm prices to rise relative to nonfarm prices. Again, this is consistent with the casual inspection of data discussed earlier and the predictions of both the differing elasticities of supply story and the overshooting model. The coefficient sign, however, rejects the implications of a Barro-type analysis based on differing elasticities of demand. Relaxing the model to allow for lagged responses to a money shock changes little as the FPE criterion suggests deleting the expected M1 measure from the regression and retaining only the contemporaneous term for unexpected growth in M1; the results from this estimation are in the second row of table 4.

<u>The Overshooting Model</u>

Based on results derived in Section II of the Appendix, the overshooting model can be estimated in its basic form--equation (1) discussed earlier--or a more general form shown as equation (3) below:

(3) $\Delta p_f = \beta_0 + \beta_1 \Delta p_m + \beta_2 \Delta m + \beta_3 \Delta \mu + \beta_4 \Delta y + \varepsilon$;

note that (6) maintains the two original hypotheses ($\beta_2 > 1$; $\beta_3 > 1$) implied by equation (1). Equation (3) also adds the change in the price of manufactured good ΔP_m and the growth of real output Δy as explanatory variables. The hypotheses embodied in (3) and the earlier equation (1) were tested over the same periods reported earlier with output measured by industrial production. Prices of manufactured goods were measured first by the PPI for industrial commodities and then, following Rausser (1985), by the CPI for food.[12/] The change in the expected money growth rate, $\Delta\mu$, was calculated as the first differences of fitted values from the money growth autoregression discussed earlier. Results of the estimations are reported in Table 5.

The results for both the restricted and more general forms of the overshooting model indicate a significant contemporaneous relationship between the growth rate of M1 and the PPI for food products, consistent with earlier results reported by Belongia and King (1983) and Lombra and Mehra (1983). The crucial question for the overshooting model, however, is whether the coefficients associated with the growth rate of M1 and the change in the expected growth rate of M1 are significantly greater than 1. For Δm, its coefficient in each of the three regressions is not significantly different from one. This rejects the prediction of the overshooting model but is consistent with the usual neoclassical result that growth in the money stock and nominal prices move together. Similarly, the coefficient associated with $\Delta\mu$, the expected growth rate of money, is not significantly different from one in any of the three equations even though each is negative numerically. Again the implication is a rejection of the overshooting model. Of the remaining variables, real income growth is associated with increases in farm prices, but the estimated income coefficients in rows

2 and 3 of the table are less than one. Manufacturing prices have no significant effect on farm prices.

Finally, the basic form of equation (3) was expanded to permit lagged adjustments in addition to contemporaneous effects of money growth. This estimation, reported in the last row of table 5, again indicates that the effect of money growth on the growth of nominal farm prices is not significantly different from one and the overshooting model's prediction is rejected. Moreover, consistent with earlier results, the adjustment of farm prices to changes in other variables is shown to occur with a short lag.

CONCLUSIONS

A considerable literature has developed on the response of the farm/nonfarm price ratio to monetary shocks. Although understanding how changes in monetary policy affect farm prices is important to the debate about changes in farm programs, alternative approaches to this question have produced empirical results that span the entire range, from monetary shocks having persistent positive effects on relative prices to having persistent negative effects; still other studies have found little impact. Moreover, because these studies have differed in many respects, it has not been possible to make direct comparisons of the results.

Testing alternative theoretical models with a consistent data set, however, uniformly rejected the notion that farm prices overshoot their long-run equilibrium values or that input prices paid by farmers rise faster than farm product prices, creating a "cost-price squeeze." The only theoretical argument consistent with the data and estimated relationships is that the supply of farm products is more inelastic in the short run than the supply of nonfarm products. Under these conditions a given shock to aggregate demand will cause prices for the good with the more inelastic supply function to rise.

Throughout, however, estimated lag lengths for monetary shocks were short, indicating that the farm/nonfarm price ratio returned to pre-shock values within two months. Therefore, regardless of the direction of relative price change, the adjustment process does not appear to be a protracted event that requires a cushion in the form of current farm programs. Moreover, the VAR results suggested that money shocks explained less than 10 percent of the variance in the relative price ratio. Qualitatively, these results indicate that changes in monetary policy are not likely to be a source of large or long-lived disruptions to the farm-nonfarm price ratio.

APPENDIX

I. DERIVATION OF THE BARRO MODEL REGRESSION EQUATION

To represent how prices would be determined within this framework, we specify: (A1) a demand function, (A2) a supply function and, (A3) a market clearing identity for a particular market as below:

(A1) $Q_t^d = \alpha - \beta * RP_t + \delta_t^d + v_t$

(A2) $Q_t^s = \Upsilon * RP_t + \delta_t^s + u_t$

(A3) $Q_t^d = Q_t^s$

where:

Q_t^d is quantity demanded;

Q_t^s is quantity supplied;

RP_t is relative price of farm output;

δ_t^d represents a demand shock;

δ_t^s represents a supply shock;

α, β, and Υ are structural parameters;

t is time; and u_t and v_t are serially uncorrelated error terms ~ $N(0, \sigma^2)$.

Solving for RP_t, we have:

(A4) $RP_t = \frac{\alpha}{\Upsilon+\beta} + \frac{1}{\Upsilon+\beta} \delta_t^d - \frac{1}{\Upsilon+\beta} \delta_t^s + \varepsilon_t$.

In this form, equation (A4) indicates that a good's relative price will be affected if unanticipated events shift its supply and/or demand functions from their expected positions. The aggregate demand shock, for empirical purposes, is taken to be the unexpected change in the growth rate of money.

To simplify the estimation and investigate the particular effect of nominal surprises on demand, we follow Barro (1976) and Hercowitz by assuming that supply shocks follow a random walk. If supply shocks are caused by random events, such as changes in weather, they have zero mean and variance σ^2 and supply-side innovations are captured by the random error term in (A4); one check on the validity of this assumption will be the absence of significant autocorrelation in the residuals of its empirical version. End of Appendix section I.

II. DERIVATION OF THE OVERSHOOTING MODEL

Under the assumption that real output is fixed and prices of manufactured (nonfarm) goods cannot adjust in the short run, Frankel's (1986) adaptation of the overshooting model derived the following expression from which his conclusions about the effects of monetary policy were drawn:

$$\text{(A5)} \quad \Delta p_f = \frac{1 + \lambda\theta}{1 - \alpha + \lambda\theta} \Delta m + \lambda \frac{1 + \lambda\theta}{1 - \alpha + \lambda\theta} \Delta\mu,$$

where p_f is the log-level of farm prices, m is the log-level of the nominal money stock, μ is the expected growth rate of the nominal money stock, α is the weight represented by farm products in the aggregate price index, λ is the semi-elasticity of money demand with respect to the interest rate and Δ indicates first difference. For consistency, we will call his basic commodity "farm products" and manufactured goods "nonfarm products." In equation (A5), then, because the coefficients of both Δm and $\Delta\mu$ are greater than one, an increase in either the level (m) or expected growth rate (μ) of the nominal money stock will cause farm prices to overshoot their long run equilibrium values.

This restricted form of the model can be made more general by relaxing the assumptions of fixed output and manufacturing prices. With a more general expression for changes in basic commodity prices, a less restrictive model of money's effects on relative prices could be tested. To derive the more general equation, start with the money demand expression employed by Frankel:

(A6) $m - p = \phi y - \lambda i$,

where p is the log of the aggregate price level, y is the log of real output, i is the short-term nominal rate of interest and λ is the semi-elasticity of money demand with respect to the interest rate. This expression can be solved for the change in the aggregate price level as:

(A7) $\Delta p = \Delta m - \phi\Delta y + \lambda\Delta i.$

Employing the weights for basic (farm) commodities $(1-\alpha)$ and manufactured (nonfarm) goods (α) in the aggregate price level, the overall change in the price level can be rewritten as:

(A8) $(1-\alpha)\Delta p_f + \alpha\Delta p_m = \Delta m - \phi\Delta y +$
$\lambda\Delta i.$

Substituting Frankel's equation (19) for Δi in (4) and solving for Δp_c yields:

$$\text{(A9)}\quad \Delta p_f = \left(\frac{-\alpha}{1-\alpha+\lambda\theta}\right)\Delta p_m + \left(\frac{1+\lambda\theta}{1-\alpha+\lambda\theta}\right)\Delta m + \left(\frac{\lambda(1+\theta\lambda)}{1-\alpha+\theta\lambda}\right)\Delta\mu - \left(\frac{1}{1-\alpha+\lambda\theta}\right)\Delta y.$$

In other words, relaxing the restrictions on y and p_m makes it possible to test the effects of changes in money on farm prices, in addition to examining how farm prices may vary with changes in output and prices of manufactured goods. This generality introduces an empirical problem, however. In equation (A5), the RHS variables involved only the money stock, which could be regarded reasonably as exogenous with respect to farm prices. In equation (A9), it is unlikely that Δp_m and Δy are exogenous and a simultaneity problem of some degree exists.

FOOTNOTES

*The author is senior economist at the Federal Reserve Bank of St. Louis. David Orden and Luther Tweeten provided helpful comments on the analysis presented in an earlier version of this paper. Paul Crosby provided research assistance.

1/ See, for example, Gardner (1987), who discusses the economic forces that are associated with the origin and expansion of farm programs. Moore (1987) also reviews arguments that have been used to rationalize farm programs.

2/ See King (1979). H. Gregg Lewis (1962, 1986) has made a similar point in his reviews of union effects on labor markets.

3/ See, for example, Barro (1976).

3a/ Historically, this assumption has been supported by the data with estimates of the income elasticity for food demand near 0.2 and higher estimates for nonfood items.

4/ See Starleaf (1982).

5/ See Frankel (1986) and Rausser (1985), for example.

6/ Certainly important among the remaining effects is the 1983 payment-in-kind (PIK) program.

7/ The Producer Price Index is divided into 16 main categories. PPI-farm represents two of these while PPI-nonfarm (industrial commodities) represents the remaining 14 categories. The prices paid and prices received indexes are designed to represent, respectively, a bundle of inputs typically purchased by farmers and an output bundle typically sold by farmers. A description of these measures can be found in _______________.

8/ If only the PPI date were compared, ti could be argued that the greater variation in the farm price index was due to its smaller number of component categories. That is, the larger number of categories in the nonfarm index would tend to smooth, or average, large individual price changes so that it would have a lower variance. For a discussion of this effect and an example, see Santoni (1983). Because the same pattern is revealed by the prices paid and prices received indexes, however, this result seems to be more than a purely statistical phenomenon.

9/ A useful overview of VARs applied to this end is in Orden (1986). Orden's results, which in some respects support the cost-price squeeze model of Tweeten, nonetheless can be interpreted as providing evidence that "monetary policy does not have powerful effects on agricultural exports or relative prices because shocks to the money supply variable have only small impacts on the agricultural variables (p. 26)." Because Orden uses quarterly data that span many periods affected by large exogenous shocks--the shift to floating exchange rates, wage and price controls, among others--and does not select lag lengths on the basis of pre-test statistics, new evidence from a monthly VAR is presented here. Admittedly, the new sample period is open to similar criticism but these additional results can be veiwed as information on the sensitivity of results to sample period. Vector autoregressions have been criticized on many grounds (see Cooley and LeRoy for a survey), most notably their lack of relationship to any underlying structure and their somewhat arbitrary selection of lag lengths and exclusion of potential explanatory variables. The latter issue of lag length selection is particularly important in view of results by Batten and Thornton (1984) and Hafer and Sheehan (1987), which show reduced form equations and VAR models to be sensitive to this choice.

10/ The Box-Pierce Q-statistic for white noise residuals from this estimation was ______, less than the critical value of _______. The experiment was repeated with monthly data. Explanatory power of the regressions was reduced and coefficient standard errors were increased. Restricting the regression intercept to zero also produced results inferior to those reported.

[11] See Batten and Thornton (1984).

[12] Comparing farm gate prices with retail food prices seems to be more of a test of the responsiveness of food processing costs--which are quite likely to make sticky adjustments in the presence of labor contracts and the like--than one of a market's auction price characteristics. A more appropriate comparison would seem to be, say, adjustments in farm prices relative to crude nonfarm materials prices, abstracting in both cases from the irrelevant issue of how marketing costs adjust to monetary shocks. Although the CPI may not be the best proxy for the purposes at hand, it is repeated here to facilitate comparisons of results.

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Table 1
Descriptive Statistics for Farm and Nonfarm Prices (first differences of logarithms, monthly data, January 1976 - February 1987)

	Mean	Deviation	Minimum	Maximum
PPI-farm products	1.18	28.12	-69.52	102.91
PPI-industrial commodities	5.23	7.45	-18.58	35.04
Prices received by farmers	1.62	25.59	-81.54	73.31
Prices paid by farmers	5.40	10.79	-15.00	47.06
PPI-farm/PPI-nonfarm	-4.04	28.54	-72.61	91.12
Prices received/prices paid	-3.65	23.34	-81.54	64.58

Table 2
Single Equation Results

Dependent Variable	Explanatory Variables: Relative Prices	M1	Exchange Rate	Industrial Production	$\bar{R}^2$	DW
Relative Prices	-0.588	0.036	-0.494	0.060	0.26	1.97
	(3.03)	(1.06)	(2.93)	(3.02)		
	1-6	0-1	0-7	0		
M1	0.547	0.096	-1.141	---	0.20	1.91
	(2.26)	(0.73)	(2.29)	---		
	0	1-4	0-2	---		
Exchange Rate	-0.126	---	0.258	0.042	0.10	1.96
	(1.59)	---	(3.13)	(2.32)		
	0	---	1	0		
Industrial Production	1.816	0.795	1.010	0.658	0.40	2.02
	(4.53)	(4.50)	(3.11)	(6.45)		
	0-1	0-3	0	1-5		

NOTE: t-statistics in parenthesis apply to sums of lag coefficients and apply to the null hypothesis that the sum is equal to zero.

Table 3
VAR Variance Decomposition: Twelve Month Ahead Forecast Error Variances

Dependent Variable	Innovations Series: Relative Prices	M1	Exchange Rate	Industrial Production
Relative Price	72.93	9.36	13.42	4.29
	79.07	2.58	13.19	5.15
	72.93	8.73	13.19	5.15
M1	1.57	89.00	9.18	0.25
	4.70	85.24	9.58	0.48
	1.57	88.37	9.58	0.48
Exchange Rate	0.49	1.84	96.53	1.14
	0.74	1.46	94.62	3.17
	0.49	1.71	94.62	3.17
Industrial Production	5.58	24.07	9.68	60.66
	7.93	19.17	9.63	63.26
	5.58	21.52	9.63	63.26

NOTE: Row 1 variable ordering: Relative Price, Industrial Production, Exchange Rate, M1

Row 2 variable ordering: M1, Relative Price, Exchange Rate, Industrial Production

Row 3 variable ordering: Relative Price, M1, Exchange Rate, Industrial Production

Table 4
Impacts of Monetary Shocks on Relative Prices in a Barro Model

Intercept	Expected $\dot{M}$	Unexpected $\dot{M}$	$\bar{R}^2$	DW
-4.520	0.056	1.044	-0.05	1.60
(0.51)	(0.05)	(2.94)		
	0-1	0-1		
-4.198	--	1.069	0.06	1.58
(1.70)	--	(2.97)		
		0		

NOTE: Third line of numbers in the bottom row of the table indicates lags estimated. Numbers in parentheses for bottom regression are t-statistics for the sums of the lag coefficients.

Table 5
Results from Overshooting Models

Intercept	Δm	$\Delta \mu$	Δy	Δp_m	$\bar{R}^2$	DW
-5.13	0.765	-0.683	--	--	0.02	1.55
(1.36)	(2.21)	(0.92)	--	--		
-9.604	0.803	-0.697	0.539	0.468[a]	0.06	1.65
(2.18)	(2.30)	(0.77)	(2.32)	(1.43)		
-7.406	0.717	-0.598	0.548	0.143[b]	0.05	1.63
(1.29)	(1.99)	(0.66)	(2.34)	(0.27)		
4.287	0.273	--	0.283	0.44[a]	0.10	1.73
(0.88)	(0.64)	--	(0.93)	(1.36)		
	0-1	--	0-2	0		

a/ P_m is measured by PPI-industrial commodities
b/ P_m is measured by CPI-less food

NOTE: Third line of numbers in the bottom row of the table indicates lags estimated. Numbers in parentheses for bottom regression are t-statistics for the sums of the lag coefficients.